

Adverse Childhood Experiences (ACEs), Resiliency, and Academic Performance in Veterinary Students


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Abstract: Studies have shown Adverse Childhood Experiences (ACEs) to be associated with reduced academic performance. To the best of our knowledge, there are no studies on ACEs and academic performance in veterinary students. We conducted a survey among veterinary students to collect data on ACEs and demographics. We linked survey data to repository data (GPA and resilience data as measured by the 10-item Connor-Davidson Resilience Scale [CD-RISC]). In total, 119 students completed the ACE questionnaire. Out of these, we linked 97 records for GPA and 85 records for resilience. The prevalence of having three or more ACEs was 63.9%. We found that having one or more ACE was associated with approximately a 4% decrease in GPA (%). The mean resilience (31.2 ± 6.9 [sd]) was close to previously reported general population estimates, although it fell below the reported population median. During the didactic curriculum, resilience tended to increase over time with periodic dips in December. Resilience was not significantly associated with GPA and did not temper the negative effects of ACEs on GPA. Still, this population is likely to benefit from resilience training. Academic performance among students with high ACEs may not be improved with resilience training. However, larger studies should confirm this finding.

Keywords: Trauma, Resiliency, Academic performance, Veterinary students

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Introduction

Adverse Childhood Experiences (ACEs) are potentially traumatic events that occur during childhood (less than 18 years old), such as neglect, abuse, guardian substance use, and household instability (Felitti et al., 1998;

Cronholm et al., 2015). ACEs are associated with risk factors for morbidity and mortality, including smoking, severe obesity, lack of physical activity, depression, and suicidal behavior (Felitti et al., 1998). In the veterinary field, there is a high prevalence of burnout, depression, and anxiety (Nahar et al., 2019; Best et al., 2020). In a previous study in veterinary students, 22.7% reported having three or more ACEs. Higher ACE scores were associated with greater risk of depression and higher than average stress (Strand et al., 2017).

To the best of our knowledge, no studies have investigated the association of ACEs with academic performance in veterinary students. More ACEs have been shown to be associated with academic issues such as reduced grade point average (GPA) (Watt et al., 2021), remediation (Williams et al., 2021), and longer time to degree attainment (Otero, 2021). In recent years, resiliency and resiliency training have been a focus of veterinary student well-being research (Moffett and Bartram, 2017). Previous research has shown that resiliency moderates the association of ACEs on mental health outcomes (Logan-Greene et al., 2014; Zaw et al., 2022) and has been shown to be associated with lower stress, anxiety, depression, burnout, and secondary traumatic stress in veterinarians (Perret et al., 2020). Previous studies have demonstrated an association between resilience and academic performance (Sadoughi, 2018), so it is possible that resilience lessens the negative effect of ACEs on academic performance.

Due to the lack of research on the effect on ACEs on academic performance in veterinary students, we aim to assess the association with ACEs and GPA and investigate the potential moderating protective effect of resiliency in a sample of veterinary students.

In this study, our objectives were as follows:

- Objective 1) report the prevalence and demographic risk factors for having three or more ACEs,
- Objective 2) report the level of resilience and its associated factors, and
- Objective 3) investigate the association of ACEs and resiliency with academic performance in veterinary students.

Method

Survey Methodology

After obtaining university Institutional Review Board approval (IRB #1156), this study was conducted January 2023 among veterinary students at a private university in Central Appalachia. The survey instrument collected demographic information (see Table 1) and responses for the expanded Adverse Childhood Experiences (ACEs) scale (Cronholm et al., 2015) in Qualtrics survey software (Provo, Utah). Survey invitations were sent out via e-mail using class directories. All students in graduating classes 2024 through 2027 were invited to participate. The responses were linked to student repository data, including GPA and resiliency (as measured using the 10-item Connor-Davidson Resilience Scale [CD-RISC]) (Campbell-Sills & Stein, 2007). The resiliency data in the repository was collected from students at multiple time points (August 2021, December 2021, May 2022,

August 2022, December 2022, January 2023, and May 2023).

Statistical Analysis

Data Cleaning

Stata version 18.0 (College Station, TX) was used for all statistical analyses. Observations were dropped that were missing any of the ACE scale items. The Philadelphia Adverse Childhood Experiences (PHL ACEs) scoring method was used to categorize respondents as having 0 ACEs, 1-2 ACEs, or 3 or more ACEs (Cronholm et al., 2015).

Objective 1) Report the prevalence and demographic risk factors for high ACE scores

Associations between ACE scores (0 ACEs, 1-2 ACEs, and 3 or more ACEs) and demographic factors were tested using the Fisher's exact test.

Objective 2) Report the level of resilience and its associated factors

The association of demographic characteristics with resilience was tested in bivariable analyses using independent t-tests or Analysis of Variance (ANOVA). In addition, trends in resilience by class year and by semester were tested using a linear mixed regression model using the 'mixed' command. Random intercepts for class year and student were included in the models to account for shared variance of class year and repeated measures, respectively. Normality and heteroskedasticity of residuals were tested by visually inspecting histograms and boxplots, respectively.

Objective 3) Investigate the association of ACEs and resiliency with academic performance

The associations of ACEs and resilience with GPA were tested in bivariable and multivariable linear mixed regression models using the 'mixed' command. The most recently available resilience score per student was used. In the multivariable model, moderation of resilience on the association of ACE score and GPA was evaluated by testing an interaction term between ACE score and resilience for statistical significance. Demographic variables significant in the bivariable analyses were eligible for inclusion in the multivariable model. Final variables were selected through backwards selection at a $P \leq 0.05$.

Results

The survey was emailed to approximately 475 students and 123 students responded. After removing students that did not answer each of the ACE scale items ($n=4$), 119 observations remained for analysis. Using the repository data, we were able to link ACE scores to resilience scores for 85 students and average GPA for 97

students. The majority of respondents were white (89.9%), female (84.0%), and <31 years old (93.3%), which reflected the underlying veterinary student population.

Objective 1: Report the prevalence and demographic risk factors for high ACE scores

Most respondents (63.9%) reported having 3 or more ACEs, followed by 1-2 ACEs (25.2%), and 0 ACEs (10.9%) (see Table 1). Only marital status and income were significantly associated with ACE score. The highest prevalence of having 3 or more ACEs among those that were married (83.3%) followed by coupled (74.1%). Those that reported an income of <\$50,000 had higher prevalence of 3 or more ACEs compared to higher income groups.

Table 1: Distribution of ACE scores by demographic factors (n=119)

Demographic variable	0 ACES (n = 13)		1-2 ACES (n = 30)		3+ ACES (n = 76)		p-value
	n	% within row	n	% within row	n	% within row	
<i>Gender</i>							0.5
Male (n=18)	3	16.7	3	16.7	12	66.7	
Female (n=100)	10	10	27	27	63	63	-
<i>Race</i>							0.53
White (n=107)	0	0	26	24.3	68	63.6	-
Non-White or Multi-Racial (n=12)	13	12.2	4	33.3	8	66.7	-
<i>Age</i>							0.36
19-24 (n=54)	5	9.3	17	31.5	32	59.3	-
25-30 (n=57)	7	12.3	13	22.8	37	64.9	-
31+ (n=8)	1	12.5	0	0	7	87.5	-
<i>Marital Status</i>							0.03
Married (n=24)	1	4.2	3	12.5	20	83.3	-
Coupled (n=27)	4	14.8	3	11.1	20	74.1	-
Separated, Divorced, Widowed, or Never Married (n=68)	8	11.8	24	35.3	36	52.9	-
<i>Income</i>							0.02
\$0-24,999 (n=54)	7	10.9	16	25	41	64.1	-
\$25,000-49,999 (n=24)	1	4.2	2	8.3	21	87.5	-
\$50,000-74,999 (n=15)	4	26.7	4	26.7	7	45.7	-
\$75,000 or more (n=16)	1	6.3	8	50	7	43.8	-
<i>Children</i>							0.73
Yes (n=4)	0	0	0	0	4	100	-

	0 ACES (n = 13)		1-2 ACES (n = 30)		3+ ACES (n = 76)		
Demographic variable	n	% within row	n	% within row	n	% within row	p-value
<i>Employed</i>	No (n=115)	13	11.3	30	26.1	72	62.6
							-
							0.13
	Yes (n=24)	0	0	8	33.3	16	66.7
	No (n=95)	13	13.7	22	23.2	60	63.2

Censored data: gender (n=1)

Objective 2: Report the level of resilience and its associated factors

The overall mean \pm sd for resilience (CD-RISC) was 31.2 ± 6.9 . White students had significantly higher resilience scores (31.8 ± 0.8) compared to non-white or multi-racial students (26.8 ± 1.6 ; see Table 2). No other demographic factors were significantly associated with resilience.

Table 2: Mean resilience (CD-RISC) by demographic factor (n=85)

		n	mean	sd	p-value
Gender					
	Male	12	30.7	2.0	0.79
	Female	73	31.3	0.8	
Race					
	White	75	31.8	0.8	0.02
	Non-White or Multi-Racial	10	26.8	1.6	
Age					
	19-24	47	30.9	7.2	0.51
	25-30	31	32.3	6.6	
	31+	7	29	3	
Marital Status					
	Married	19	32.3	8.1	0.6
	Coupled	18	31.8	6.1	
	Separated, Divorced, Widowed, or Never				
	Married	48	30.5	6.7	
Income					
	\$0-24,999	45	30.9	7.4	0.81
	\$25,000-49,999	17	30.4	6	
	\$50,000-74,999	11	32.9	7.9	
	\$75,000 or more	12	31.6	5.6	
Children					
	Yes	4	34.5	0.8	0.53

		n	mean	sd	p-value
<i>Employed</i>	No	81	31	4.9	0.93
	Yes	20	31.3	1.4	
	No	65	31.1	0.9	

Resilience tended to decrease in December each year (see Figure 1). Overall, the highest resilience levels were reported in May 2023. During course of the didactic curriculum, resilience levels tended to increase over time, with periodic dips in December (see Figure 3). Resilience was highest at the end of the students' last didactic year (Year 3, Semester 2 [Y3,S2,May]).

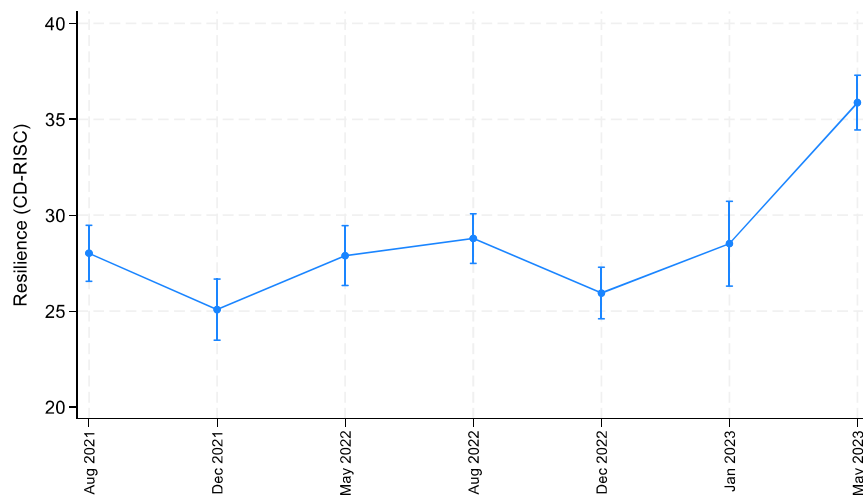


Figure 1: Veterinary student resilience (CD-RISC) over time

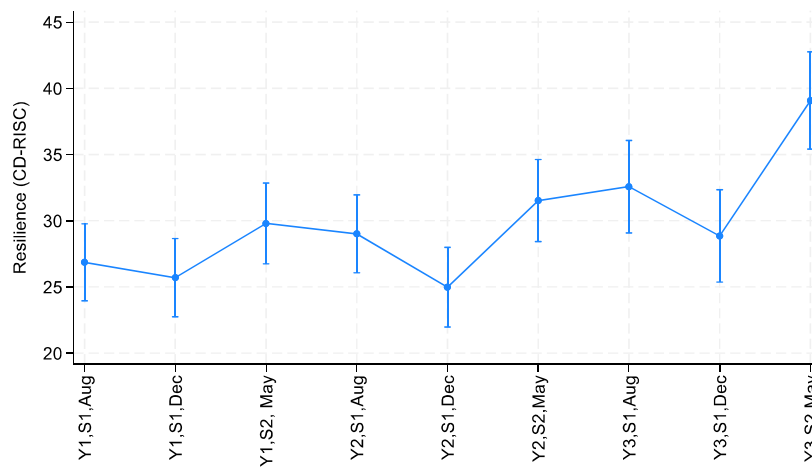


Figure 2: Veterinary student resilience by semester (Y1,S1 = Year 1, Semester 1)

Objective 3: Investigate the association of ACEs and resiliency with academic performance

GPA (% out of 100) was significantly lower among students with at least one ACE compared to no ACEs (see Figure 3). On average, those with 0 ACEs had grades that were about 4% higher compared to those with ACEs. Resilience was not significantly associated with GPA and there was no significant moderation of resilience and ACE score on GPA (data not shown). No variables except ACE score were retained in the final multivariable model predicting GPA (see Table 3).

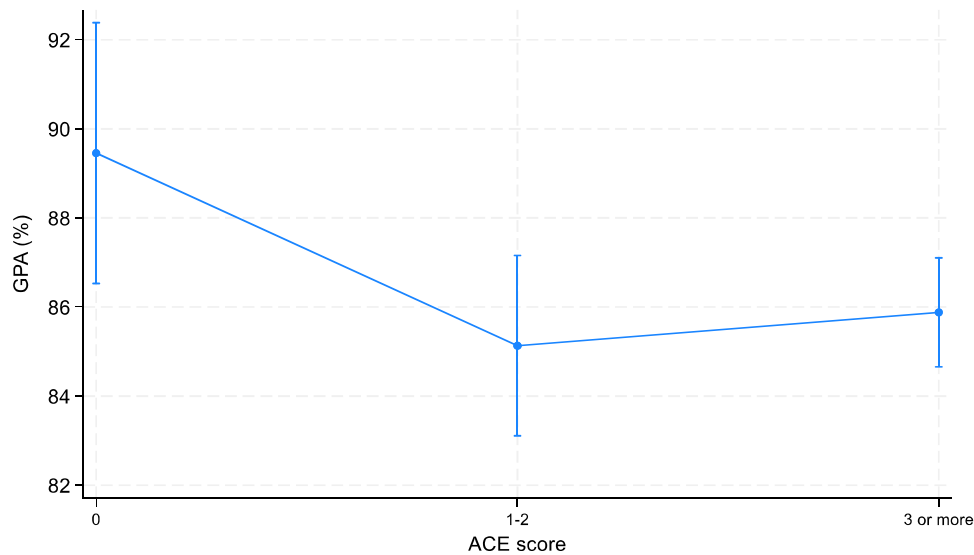


Figure 3: GPA (%) by ACE score in veterinary students

Table 3: Regression model predicting GPA (%) in veterinary students (n=97)

	Coefficient	SE	p-value	[95% conf. interval]
ACE score				
0 (reference)				
1 or 2	-4.32	1.82	0.017	(-7.88, -0.76)
3 or more	-3.58	1.62	0.027	(-6.75, -0.40)
Intercept	89.46	1.49	<0.01	(86.53, 92.38)

Discussion

In this study, we evaluated the association of resiliency and Adverse Childhood Experiences (ACEs) on GPA in veterinary students. We found that having at least one ACE was associated with lower GPA compared to having no ACEs. This is similar to previous studies in other non-veterinary student populations, which found that higher ACE scores were associated with poorer academic outcomes, including reduced grade point average

(GPA) (Watt et al., 2021), remediation (Williams et al., 2021), and longer time to degree attainment (Otero, 2021).

We did not find an association between resiliency and GPA, which contrasts with findings in previous studies which found that resilience was associated with better academic outcomes in a variety of populations, including undergraduate medical students (Pop-Velea, et al., 2021), general undergraduate students (Hartley, 2011), and teacher trainees (Karabiyik, 2020). The overall mean CD-RISC score in our study was similar to previously reported general population samples (Campbell-Sills et al., 2008). Although according to Campbell-Sills et al., 2008, our sample falls in the second quartile, below the overall population median. This provides evidence that veterinary students are in need of resilience training (Moffett & Bartram, 2017). The lowest levels of resilience during the academic year occurred in December. In addition, resilience was lower earlier on in the didactic curriculum. The increased resilience over time could be due to the resilience training that is currently implemented in the curriculum or as a natural result of the student progressing through veterinary school and gaining confidence. Either way, these findings suggest optimum times for resilience training are early in the curriculum and prior to winter break.

We did not find a moderating effect of resilience on the association of ACEs and academic performance. This is similar to a previous study that found that there were no differences in resilience or GPA among college students with different levels of developmental trauma (Arnekrans et al., 2018). This indicates that resilience training may not be an effective intervention to improve academic performance among students with high ACE scores. However, the limited sample size of ACE data linked with resilience data ($n=85$) could have limited power to detect a significant association. Either way, resilience training is beneficial as it has been shown to moderate the association of ACEs and mental health outcomes (Logan-Greene et al., 2014; Zaw et al., 2022).

To the best of our knowledge, this is the first study that evaluated the association of ACEs and GPA in veterinary students. In a previous study, the prevalence of having three or more ACEs was 22.7% in veterinary students (Strand et al., 2017). This is similar to another estimate of 24.6% found in a nationally representative sample of United States adults (Merrick et al., 2018). In our study, the prevalence of having three or more ACEs was much higher, at 63.9%. Many of the students in the sample were likely from Appalachia, which is greatly heterogeneous in socioeconomic status and culture, but has areas that are historically underserved that have greater poverty, lower educational attainment, and higher rates of cancer, heart disease, and mortality (Thorne et al., 2004; Behringer & Friedell, 2006). Although we did not compare Appalachian students versus non-Appalachian students in the analysis, the university's mission is to serve Appalachia and admits many students from Appalachia. However, the increased prevalence in our study could partially be an artifact of the version of the ACE questionnaire that was used. In this study, we used the expanded ACE questionnaire which included additional items on bullying, community violence, neighborhood safety, racism, and foster care (Cronholm et al., 2015). However, in a large sample of adults in Philadelphia, the prevalence of having three or more ACEs using the Expanded ACE questionnaire was only 10.1%, which is much lower than the estimate in our sample (Wade et al., 2016). Lastly, the higher prevalence reported in our study may be due to volunteer bias, which

occurs when those that volunteered to take the study were different than the underlying population. For example, those that experienced ACEs may be more likely to respond to this survey. Still, this study provides evidence that many of our students have experienced ACEs and that they may benefit from additional support.

Conclusion

We found a high prevalence (63.9%) of having three or more ACEs among veterinary students. Veterinary students with at least one ACE had significantly lower GPAs compared to students with no ACEs. Resilience was not significantly associated with GPA and did not have a moderating effect on the association of ACE score with GPA. Resilience trended upwards during the didactic curriculum with periodic dips in December, indicating optimum timepoints for intervention.

Recommendations

Veterinary students may benefit from resilience training early in the didactic curriculum and prior to winter break each year. Since resilience was not significantly associated with GPA in this study, additional interventions may be better suited to improve academic outcomes in students with high ACE scores, such as implementing policies, training, and curriculum that will support these students. However, larger studies should be conducted to confirm the lack of association of resilience with GPA. In addition, future studies should confirm the high prevalence of having three or more ACEs in veterinary students (63.9%) we found in this study.

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